

J02 Recd PCT/IB 21 MAR 2000

12. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)), i.e., **before 18th month from first priority date above in item 3, are transmitted herewith (file only if in English) including:**
13. ☒ PCT Article 19 claim amendments (if any) have been transmitted by the International Bureau
14. ☐ Translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)), i.e., of **claim amendments** made before 18th month, **is attached (required by 20th month from the date in item 3 if box 4(a) above is X'd, or 30th month if box 4(b) is X'd, or else amendments will be considered canceled).**
15. **A declaration of the inventor** (35 U.S.C. 371(c)(4))
- a. ☐ is submitted herewith ☐ Original ☐ Facsimile/Copy
- b. ☒ is not herewith, but will be filed when required by the forthcoming PTO Missing Requirements Notice per Rule 494(c) if box 4(a) is X'd or Rule 495(c) if box 4(b) is X'd.
16. **An International Search Report (ISR):**
- a. Was prepared by ☐ European Patent Office ☐ Japanese Patent Office ☐ Other
- b. ☒ has been transmitted by the international Bureau to PTO.
- c. ☐ copy herewith (___ pg(s).) ☐ plus Annex of family members (___ pg(s).)
17. **International Preliminary Examination Report (IPER):**
- a. ☒ has been transmitted (if this letter is filed after 28 months from date in item 3) in English by the International Bureau with Annexes (if any) in original language.
- b. ☐ copy herewith in English.
- c.1 ☐ IPER Annex(es) in original language ("Annexes" are amendments made to claims/spec/drawings during Examination) including attached amended:
- c.2 ☐ Specification/claim pages # ___ claims # ___
- Dwg Sheets # ___
- d. ☐ Translation of Annex(es) to IPER **(required by 30th month due date, or else annexed amendments will be considered canceled).**
18. **Information Disclosure Statement** including:
- a. ☒ Attached Form PTO-1449 listing documents
- b. ☐ Attached copies of documents listed on Form PTO-1449
- c. ☒ A concise explanation of relevance of ISR references is given in the ISR.
19. ☐ **Assignment** document and Cover Sheet for recording are attached. Please mail the recorded assignment document back to the person whose signature, name and address appear at the end of this letter.
20. ☐ Copy of Power to IA agent.
21. ☐ **Drawings** (complete only if 8d or 10a(4) not completed): ___ sheet(s) per set: ☐ 1 set informal; ☐ Formal of size ☐ A4 ☐ 11"
22. Small Entity Status ☐ is **Not** claimed ☐ is claimed (**pre-filing confirmation required**)
- 22(a) ___ (No.) Small Entity Statement(s) enclosed (since 9/8/00 Small Entity Statements(s) not essential to make claim)
23. **Priority** is hereby claimed under 35 U.S.C. 119/365 based on the priority claim and the certified copy, both filed in the International Application during the international stage based on the filing in (country) Finland of:
- | Application No. | | Filing Date | Application No. | | Filing Date |
|-----------------|--------|---------------|-----------------|-------|-------------|
| (1) | 982027 | 21 Sept. 1998 | (2) | _____ | _____ |
| (3) | _____ | _____ | (4) | _____ | _____ |
| (5) | _____ | _____ | (6) | _____ | _____ |
- a. ☒ See Form PCT/IB/304 sent to US/DO with copy of priority documents. If copy has not been received, please proceed promptly to obtain same from the IB.
- b. ☐ Copy of Form PCT/IB/304 attached.

25. **Preliminary Amendment:** See attached25.5 Per Item 17.c2, **cancel original** pages # _____, claims # _____, Drawing Sheets # _____26. **Calculation of the U.S. National Fee (35 U.S.C. 371 (c)(1)) and other fees is as follows:**Based on amended claim(s) per above item(s) ☐ 12, ☐ 14, ☐ 17, ☐ 25, ☐ 25.5 (hiliate)

Total Effective Claims	12	minus 20 =	0	x \$18/\$9	= \$0	966/967
Independent Claims	3	minus 3 =	0	x \$80/\$40	= \$0	964/965
If any proper (ignore improper) Multiple Dependent claim is present,				add \$270/\$135	+0	968/969

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(4)): →→ **BASIC FEE REQUIRED, NOW** →→→→A. If country code letters in item 1 are not "US", "BR", "BB", "TT", "MX", "IL", "NZ", "IN" or "ZA"

See item 16 re:

1. Search Report was not prepared by EPO or JPO -----	add \$1000/\$500	960/961
2. Search Report was prepared by EPO or JPO -----	add \$860/\$430	970/971
	+1000	

SKIP B, C, D AND E UNLESS country code letters in item 1 are "US", "BR", "BB", "TT", "MX", "IL", "NZ", "IN" or "ZA"

→ <input type="checkbox"/> B. If USPTO did not issue <u>both</u> International Search Report (ISR) and (if box 4(b) above is X'd) the International Examination Report (IPER), -----	add \$970/\$485	+0	960/961
(only) → <input type="checkbox"/> C. If USPTO issued ISR but not IPER (or box 4(a) above is X'd), -----	add \$710/\$355	+0	958/959
(of) → <input type="checkbox"/> D. If USPTO issued IPER but IPER Sec. V boxes <u>not all</u> 3 YES, -----	add \$690/\$345	+0	956/957
(these) → <input type="checkbox"/> E. If international preliminary examination fee was paid to USPTO and Rules 492(a)(4) and 496(b) <u>satisfied</u> (IPER Sec. V <u>all</u> 3 boxes YES for <u>all</u> claims), -----	add \$100/\$50	+0	962/963
27. SUBTOTAL =	\$1000		
28. If Assignment box 19 above is X'd, add Assignment Recording fee of ---\$40	+0	(581)	
29. Attached is a check to cover the -----	TOTAL FEES	\$1000	

Our Deposit Account No. 03-3975

Our Order No. 60258

C#

279243

M#

CHARGE STATEMENT: The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and which may be required under Rules 16-18 and 492 (missing or insufficient fee only) now or hereafter relative to this application and the resulting Official document under Rule 20, or credit any overpayment, to our Account/Order Nos. shown above for which purpose a duplicate copy of this sheet is attached.

This CHARGE STATEMENT does not authorize charge of the issue fee until/unless an issue fee transmittal form is filed**Pillsbury Winthrop LLP
Intellectual Property Group**

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NOTE: File in duplicate with 2 postcard receipts (PAT-103) & attachments.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION OF

Confirmation No.: Unknown

VERKAMA

Group Art Unit: Unknown

Appln. No.: 09/787,659

Examiner: Unknown

Filed: March 21, 2001

Title: IP MOBILITY MECHANISM FOR A PACKET RADIO NETWORK

April 17, 2001



* * * * *

SUPPLEMENTAL PRELIMINARY AMENDMENT

Hon. Commissioner of Patents
Washington, D.C. 20231

Sir:

Prior to initial examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Page 8, delete the whole paragraph 29 and replace it with the following new paragraph:

Fig. 4 is a signalling diagram illustrating the second embodiment of the invention. Signalling steps having identical reference numbers with those in Fig. 2 have identical functions, and they will not be described again. The major difference between the embodiments shown in Figs 2 and 4 is, of course, that in Fig. 4 the FA is integrated into the GGSN instead of the SGSN. Therefore, in step 3-11, the SGSN sends an FA Query to the GGSN+FA. This query is acknowledged in step 3-11'. Steps 3-14 to 3-20 correspond to respective steps 2-14 to 2-20, but they are sent to/from the GGSN, instead of the SGSN. Similarly, the Mobile IP tunnel is established from the GGSN+FA to the HA, and the

implementation permitting, also in the reverse direction.

See the attached Appendix for the changes made the effect the above paragraph.

IN THE CLAIMS:

Please cancel claim 4 without prejudice or disclaimer.

1. (Amended) A method for providing Internet Protocol-type mobility service for a mobile station in a packet radio network, the method comprising:

installing into the packet radio network a foreign agent having an IP address;

integrating the foreign agent into a first support node included in the radio packet network;

providing a care-of-address for the mobile station; and

using the IP address of the foreign agent as the mobile station's care-of-address.

2. (Amended) The method of claim 1, wherein the first support node is an access node.

3. (Amended) The method of claim 1, wherein the first support node is a gateway node.

5. (Amended) The method of claim 1, further comprising receiving an access point name from the mobile station, in connection with an attach procedure, the access point name indicating a network operator and a Mobile IP address.

6. (Amended) The method of claim 5, wherein the access point name is received

by an access node and the method further comprises sending the access point name received from the mobile station to a gateway node.

7. (Amended) The method of claim 1, further comprising storing information concerning whether the mobile station in question is allowed to use the IP-type mobility service in a register of the packet radio network.

8. (Amended) The method of claim 1, further comprising receiving information from the mobile station indicating whether the mobile station requests use of the Internet Protocol-type mobility service.

9. (Amended) An arrangement for providing IP-type mobility service for a mobile station, the arrangement comprising:

at least two support nodes, wherein at least one support node is an access node, and at least one support node is a gateway node; and

a foreign agent having an IP address being integrated into one of the support nodes;

wherein, the IP address of the foreign agent is also the mobile station's care-of-address.

10. (Amended) The arrangement of claim 9, wherein the foreign agent is integrated into the access node.

11. (Amended) The arrangement of claim 9, wherein the foreign agent is integrated into the gateway node.

12. (Amended) A support node for a packet radio network, arranged to provide mobility service for a mobile station, the support node comprising:

an integrated foreign agent having an IP address,

wherein the support node supports at least an IP-type protocol and is adapted to use the IP address of, or provided by, the foreign agent as the mobile station's care-of-address.

Please add new claims 13-14.

13. (New) The method of claim 7, wherein the register of the packet radio network is a Home Location Register.

14. (New) The method of claim 8, wherein the receiving information from the mobile station indicating whether the mobile station requests use of the Internet Protocol-type mobility service is performed in connection with mobile station registration.

REMARKS

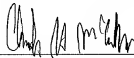
Consideration and allowance of the present application is respectfully requested. By this Amendment, claims 1-3 and 5-12 are amended to merely clarify the recited subject matter and new claims 13-14 are added to more fully claim the disclosed invention.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **“Version with markings to show changes made”**.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,
PILLSBURY WINTHROP LLP

By: _____



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Enclosure: Appendix

April 17, 2001

APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Fig. 4 is a signalling diagram illustrating the second embodiment of the invention.

Signalling steps having identical reference numbers with those in Fig. 2 have identical functions, and they will not be described again. The major difference between the embodiments shown in Figs 2 and 4 is, of course, that in Fig. 4 the FA is integrated into the GGSN instead of the SGSN. Therefore, in step [4] 3-11, the SGSN sends an FA Query to the GGSN+FA. This query is acknowledged in step [4] 3-11'. Steps [4] 3-14 to [4] 3-20 correspond to respective steps 2-14 to 2-20, but they are sent to/from the GGSN, instead of the SGSN. Similarly, the Mobile IP tunnel is established from the GGSN+FA to the HA, and the implementation permitting, also in the reverse direction.

IN THE CLAIMS:

Please cancel claim 4 without prejudice or disclaimer.

Please amend claims 1-3 and 5-12 as follows:

1. (Amended) A method for providing Internet Protocol-type[, or IP-type,] mobility service for a mobile station [(MS)] in a packet radio network, the method comprising [at least two support nodes wherein at least one support node is an access node (SGSN), and at least one support node is a gateway node (GGSN); the method being characterized by]:

installing into [said] the packet radio network a foreign agent [(FA)] having an IP address;

integrating the foreign agent [(FA)] into [one of the] a first support node included

in the radio packet network[nodes (SGSN; GGSN)]; [and]

providing a care-of-address [(COA)] for the mobile station [(MS)]; and

using the IP address of[, or provided by,] the foreign agent [(FA)] as the mobile station's [(MS)] care-of-address [(COA)].

2. (Amended) [A] The method [according to] of claim 1, [c h a r a c t e r i z e d by] wherein [integrating] the first support node is [foreign agent (FA) into] an access node [(SGSN)].

3. (Amended) [A] The method [according to] of claim 1, [c h a r a c t e r i z e d by] wherein [integrating] the first support node is [foreign agent (FA) into] a gateway node [(GGSN)].

5. (Twice Amended) [A] The method [according to] of claim 1, [c h a r a c t e r i z e d i n t h a t] further comprising receiving an access point name from the mobile station [(MS)], in connection with an attach procedure, [sends an access point name (APN)] the access point name indicating [the] a network operator and a Mobile IP address.

6. (Amended) [A] The method [according to] of claim 5, [c h a r a c t e r i z e d i n t h a t] wherein the access point name is received by an access node and the method further comprises sending the access point name received from the mobile station [(MS) sends the access point name (APN) to the access node (SGSN) and the access node sends it to] [the] a gateway node [(GGSN)].

7. (Twice Amended) [A] The method [according to] of claim 1,

[c h a r a c t e r i z e d in that] further comprising [a register of the packet radio network, preferably its Home Location Register (HLR), stores] storing information concerning whether [or not] the mobile station in question [or its subscriber] is allowed to use [said] the IP-type mobility service in a register of the packet radio network.

8. (Twice Amended) [A] The method [according to] of claim 1, [c h a r a c t e r i z e d in that] further comprising [the mobile station [(MS), preferably in connection with registering, informs] receiving information from the mobile station indicating [the packet radio network] whether [or not it] the mobile station requests [the] use of [said] the [IP-type] Internet Protocol-type mobility service.

9. (Amended) An arrangement for providing IP-type mobility service for a mobile station [(MS)], the arrangement comprising:

at least two support nodes₂ wherein at least one support node is an access node [(SGSN)], and at least one support node is a gateway node [(GGSN)];

[the arrangement being c h a r a c t e r i z e d by:

a care-of-address (COA) for the mobile station (MS)]; and

a foreign agent [(FA)] having an IP address being integrated into one of the support nodes [(SGSN; GGSN)]; [and]

wherein, the IP address of the foreign agent [(FA)] [being] is also the mobile station's [(MS)] care-of-address [(COA)].

10. (Amended) [An] The arrangement [according to] of claim 9, [c h a r a c t e r i z e d in that] wherein the foreign agent [(FA)] is integrated into [one of] the access node [nodes (SGSN)].

11. (Amended) [An] The arrangement [according to] of claim 9,
[c h a r a c t e r i z e d in that] wherein the foreign agent [(FA)] is integrated into [one of] the
gateway node [nodes (GGSN)].

12. (Amended) A support node [(GGSN, SGSN)] for a packet radio network,
arranged to provide mobility service for a mobile station [(MS), wherein the support node
(GGSN) supports at least an IP-type protocol;

c h a r a c t e r i z e d in that] , the support node comprising [(GGSN, SGSN)]:
[comprises] an integrated foreign agent [(FA)] having an IP address[; and],
wherein the support node supports at least an IP-type protocol and is adapted to
use the IP address of, or provided by, the foreign agent [(FA)] as the mobile station's [(MS)]
care-of-address [(COA)].

Inventor(s): VERKAMA, et al.

Appln. No.: 09 787,659

Series Code \uparrow Serial No. \uparrow

Filed: March 21, 2001

Hon. Commissioner of Patents
Washington, D.C. 20231



Group Art Unit Unknown
Examiner: Unknown
Atty. Dkt. P 279243
M# 2980379US
Client Ref

Appln. Title: IP MOBILITY MECHANISM FOR A
PACKET RADIO NETWORK

JC17 Rec'd PCT/PTO 17 APR 2001

Sir:

REPLY/AMENDMENT/LETTER

Date: April 17, 2001

This is a reply/amendment/letter in the above-identified application and includes the herewith attachment of same date and subject which is incorporated herein by reference and the signature below is treated as the signature to the attachment in absence of a signature thereto.

FEE REQUIREMENTS FOR CLAIMS AS AMENDED

1. Small Entity claim	Claims remaining after amendment	Highest number previously paid for	Present Extra	Large/Small Entity	Additional Fee	Fee Code Lg/Sm
A. <input checked="" type="checkbox"/> NOT made B. <input type="checkbox"/> Withdrawn C. <input type="checkbox"/> made herewith D. <input type="checkbox"/> made previously For B & C See Required Separate Paper (Pat-256)						
2. Total Effective Claims	**minus	20	0	x \$18/\$9 =	+ \$0	103/203
3. Independent Claims	***minus	3	0	x \$80/\$40 =	+ \$0	102/202
4. If amendment enters proper multiple dependent claim(s) into this application for first time (leave blank if this is a reissue application)..... add				+ \$270/\$135 =	+ \$0	104/204
5. Original due Date:	<input checked="" type="checkbox"/> NONE					
6. Petition is hereby made to extend the original due date to cover the date this response is filed for which the requisite fee is attached (1 mo) \$110/\$55 = (2 mos) \$390/\$195 = (3 mos) \$890/\$445 = (Usable only for \leq 2mo.OA --- 4 mos) \$1390/\$695= (Usable only for 30 day/1mo.OA --- 5 mos) \$1890/\$945=				+ \$0		115/215 116/216 117/217 118/218 128/228
7. Enter any previous extension fee paid since above original due date and subtract				- \$0		
8. Extension Fee Attached				+ \$0		
9. If Terminal Disclaimer attached, add Rule 20(d) official fee				+ \$110/\$55	+ \$0	148/248
10. If IDS attached requires Official Fee under Rule 97 (c), add				+ \$180	+ \$0	126
or if Rule 97(d) Request add				+ \$180	+ \$0	126
11. After-Final Request Fee per rules 129(a) and 17(r)				+ \$710/355	+ \$0	146/246
12. No. of additional inventions for examination per Rule 129(b)				x \$710/355 ea	+ \$0	149/249
13. Request for Continued Examination (RCE)				+ \$710/355	+ \$0	1179/1279
14. Petition fee for				+ \$0		
15. TOTAL FEE ENCLOSED =				\$0		

16. *If the entry in this space is less than entry in next space, the "Present Extra" result is "0".
17. **If the "Highest number previously paid for" in this space is less than 20, write "20" in this space.
18. ***If the "Highest number previously paid for" in this space is less than 3, write "3" in this space.

Our Deposit Account No. 03-3975)
(Our Order No. 60258 279243

CHARGE STATEMENT: The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and which may be required under Rules 16-18 (missing or insufficiencies only) now or hereafter relative to this application and the resulting Official Document under Rule 20, or credit any overpayment, to our Accounting/Order Nos. shown above, for which purpose a duplicate copy of this sheet is attached.

This CHARGE STATEMENT does not authorize charge of the issue fee until/unless an issue fee transmittal sheet is filed.

Query: Is appeal deadline now? If so, file Notice of Appeals separately.

Pillsbury Winthrop LLP

Intellectual Property Group

By Atty: Christine H. McCarthy

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NOTE: File this cover sheet in duplicate with PTO receipt (PAT-103A) and attachments

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the patent application of:

VERKAMA et al.

Serial No.: Unassigned

Applications Branch

Filed: March 21, 2001

Examiner: **Unassigned**

Title: IP MOBILITY MECHANISM FOR A PACKET RADIO NETWORK

* * * * *

March 21, 2001

PRELIMINARY AMENDMENT

Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified patent application, please enter the following claim amendments.

IN THE CLAIMS:

Please amend claims 4, 5, 7 and 8 as follows:

4. (Amended) A method according to claim 1, characterized by using the IP address of the foreign agent (FA) as the mobile station's (MS) care-of-address (COA).
5. (Amended) A method according to claim 1, characterized in that the mobile station (MS), in connection with an attach procedure, sends an access point name (APN) indicating the network operator and a Mobile IP address.
7. (Amended) A method according to claim 1, characterized in that a register of the packet radio network, preferably its Home Location Register (HLR), stores information concerning whether or not the mobile station in question or its subscriber is allowed to use said IP-type mobility service.

8. (Amended) A method according to claim 1, characterized in that the mobile station (MS), preferably in connection with registering, informs the packet radio network whether or not it requests the use of said IP-type mobility service.

See the attached Appendix for the changes made to effect the claims.

REMARKS

The foregoing claim amendments are made to correct multiple dependencies only. No new subject matter has been added. An early and favorable Action on the merits is respectfully requested.

Respectfully submitted,
PILLSBURY WINTHROP LLP

By: 

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Facsimile: 202-822-0944

APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

4. (Amended) A method according to [any one of the preceding claims] claim 1,
c h a r a c t e r i z e d by using the IP address of the foreign agent (FA) as the mobile
station's (MS) care-of-address (COA).
5. (Amended) A method according to [any one of the preceding claims] claim 1,
c h a r a c t e r i z e d in that the mobile station (MS), in connection with an attach procedure,
sends an access point name (APN) indicating the network operator and a Mobile IP address.
7. (Amended) A method according to [any one of the preceding claims] claim 1,
c h a r a c t e r i z e d in that a register of the packet radio network, preferably its Home
Location Register (HLR), stores information concerning whether or not the mobile station in
question or its subscriber is allowed to use said IP-type mobility service.
8. (Amended) A method according to [any one of the preceding claims] claim 1,
c h a r a c t e r i z e d in that the mobile station (MS), preferably in connection with
registering, informs the packet radio network whether or not it requests the use of said IP-type
mobility service.

09/787659

APPLICATION UNDER UNITED STATES PATENT LAWS

Atty. Dkt. No. PW 279243

(M#)

2002 Rec'd PCT/PTO 21 MAR 2002

Invention: IP MOBILITY MECHANISM FOR A PACKET RADIO NETWORK

Inventor (s): VERKAMA, Markku; FLYKT, Patrik; HAUMONT, Serge

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 Attorneys
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This is a:

- ☐ Provisional Application
- ☐ Regular Utility Application
- ☐ Continuing Application
☐ The contents of the parent are incorporated by reference
- ☒ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application
- ☐ Substitute Specification
 Sub. Spec Filed _____
 in App. No. _____ / _____
- ☐ Marked up Specification re
 Sub. Spec. filed _____
 In App. No. _____ / _____

SPECIFICATION

TITLE

IP mobility mechanism for a packet radio network

Background of the Invention

[0001] The invention relates to a mechanism for providing mobility for an Internet-type protocol in a packet radio network such as GPRS or UMTS. An example of such an Internet-type mobility protocol is the IP mobility (IP=Internet Protocol), which is the topic of standards RFC2002 to RFC2004 and RFC2290 by the Internet Engineering Task Force (IETF). These RFC standards are incorporated herein by reference. In short, IP mobility is a mechanism for providing a mobile user with telecommunications capability using an IP address. It enables mobile nodes to change their points of attachment in the Internet without changing their IP address. Thus it facilitates the communication of a mobile node and a correspondent host with the mobile node's home address. Fig. 1 illustrates some elements of a packet radio network which are relevant to the invention.

[0002] Within the context of this application, 'Network Access Server (NAS)' is a device providing users with temporary, on-demand network access. This access is point-to-point using telephone, ISDN or cellular connections, etc. 'Mobile Node (MN)' refers to a host that wants to use a Home Network address while physically connected by a point-to-point link (phone line, ISDN, etc.) to a NAS that does not reside on the Home Network. 'Mobile Station (MS)' is a mobile node having a radio interface to the network. A 'Tunnel' is the path followed by a datagram when encapsulated. The model of a tunnel is such that, while encapsulated, a datagram is routed to a known decapsulation agent, which decapsulates the datagram and then correctly delivers it to its ultimate destination. Each mobile node connecting to a home agent does so over a unique tunnel, identified by a tunnel identifier which is unique to a given Foreign Agent/Home Agent pair.

[0003] A 'Home Network' is the IP network to which a user logically belongs. Physically, it can be e.g. a local area network (LAN) connected via a router to the Internet. A 'Home Address' is an address that is assigned to a mobile node for an extended period of time. It may remain unchanged regardless of where the MN is attached to the Internet. Alternatively, it could be assigned from a pool of addresses. A 'Home Agent' is a routing entity in a mobile node's home network which tunnels

packets for delivery to the mobile node when it is away from home, and maintains current location information for the mobile node. The home agent tunnels datagrams for delivery to, and, optionally, detunnels datagrams from, a mobile node when the mobile node is away from home.

[0004] A 'Foreign Agent' refers to a routing entity on a mobile node's visited network which provides routing services to the mobile node while registered, thus allowing a mobile node to utilize its home network address. The foreign agent detunnels and delivers packets to the mobile node that were tunnelled by the mobile node's home agent. For datagrams sent by a mobile node, the foreign agent may serve as a default router for registered mobile nodes.

[0005] RFC2002 defines 'Care-of-Address' (COA) as the termination point of a tunnel toward a mobile node, for datagrams forwarded to the mobile node while it is away from home. The protocol can use two different types of care-of-address: a "foreign agent care-of-address" is an address announced by a foreign agent with which the mobile node is registered, and a "co-located care-of-address" is an externally obtained local address which the mobile node has acquired in the network. Within the context of this application, 'Care-of-Address' (COA) is an announced address of a foreign agent with which the mobile node is registered. An MN may have several COAs at the same time. An MN's COA is registered with its HA. The list of COAs is updated when the mobile node receives advertisements from foreign agents. If an advertisement expires, its entry or entries should be deleted from the list. One foreign agent can provide more than one COA in its advertisements. 'Mobility Binding' is the association of a home address with a care-of-address, along with the remaining lifetime of that association. An MN registers its COA with its HA by sending a Registration Request. The HA replies with a Registration Reply and retains a binding for the MN.

[0006] Routing data packets to an MN is a problem in a packet radio network, such as GPRS. This is because the data network address of the MN typically has a static routing mechanism, whereas a MN can roam from one subnetwork to another. One approach for data packet routing in a mobile environment is the concept of Mobile IP. Mobile IP enables the routing of IP datagrams to mobile hosts, independent of the point of attachment in the subnetwork. The standard Mobile IP concept does not fit exactly in the GPRS environment because network protocols other than IP

must be supported too. Also, mobility management within a GPRS network is based on mechanisms different from Mobile IP, which is only defined for the Internet Protocol.

[0007] The GPRS infrastructure comprises support nodes such as a GPRS gateway support node (GGSN) and a GPRS serving support node (SGSN). The main functions of the GGSN nodes involve interaction with the external data network. The GGSN updates the location directory using routing information supplied by the SGSNs about an MS's path and routes the external data network protocol packet encapsulated over the GPRS backbone to the SGSN currently serving the MS. It also decapsulates and forwards external data network packets to the appropriate data network and handles the billing of data traffic.

[0008] The main functions of the SGSN are to detect new GPRS mobile stations in its service area, handle the process of registering the new MSs along with the GPRS registers, send/receive data packets to/from the GPRS MS, and keep a record of the location of the MSs inside of its service area. The subscription information is stored in a GPRS register (HLR) where the mapping between a mobile's identity (such as MS-ISDN or IMSI) and the PSPDN address is stored. The GPRS register acts as a database from which an SGSN can ask whether a new MS in its area is allowed to join the GPRS network.

[0009] The GPRS gateway support nodes GGSN connect an operator's GPRS network to external systems, such as other operators' GPRS systems, data networks 11, such as an IP network (Internet) or an X.25 network, and service centres. Fixed hosts 14 can be connected to the data network 11 e.g. by means of a local area network LAN and a router 15. A border gateway BG provides access to an inter-operator GPRS backbone network 12. The GGSN may also be connected directly to a private corporate network or a host. The GGSN includes GPRS subscribers' PDP addresses and routing information, i.e. SGSN addresses. Routing information is used for tunnelling protocol data units PDU from the data network 11 to the current switching point of the MS, i.e. to the serving SGSN. The functionalities of the SGSN and GGSN can be connected to the same physical node.

[0010] The home location register HLR of the GSM network contains GPRS subscriber data and routing information and it maps the subscriber's IMSI into one or more pairs of PDP type and PDP address. The HLR also maps each PDP type and

PDP address pair into a GGSN node. The SGSN has a Gr interface to the HLR (a direct signalling connection or via an internal backbone network 13). The HLR of a roaming MS and its serving SGSN may be in different mobile communication networks.

[0011] The intra-operator backbone network 13, which interconnects an operator's SGSN and GGSN equipment, can be implemented, for example by means of a local network, such as an IP network. It should be noted that an operator's GPRS network can also be implemented without the intra-operator backbone network, e.g. by providing all features in one computer.

[0012] A GPRS network in its current form is able to support IP mobility if an MS implements the Mobile IP protocol and if it has a private IP address assigned by some company or Internet service provider (ISP). When a GGSN node assigns a temporary IP address to the MS, the MS can use this temporary address as its care-of-address (COA) and register the address with its home agent, thus benefiting from the Mobile IP services. This is also true when the MS is using a predefined GGSN IP address, which can also be regarded as a COA.

[0013] A problem of the temporary and predefined GGSN-assigned IP addresses in the known IP mobility mechanisms is that they consume valuable IPv4 address space because an MS requires two IP addresses, one from its home network and another one from the visited network. Moreover, the tunnelling requires that IP packets are sent to the MS using Mobile IP encapsulation, which wastes precious radio resources.

Disclosure of the Invention

[0014] An object of the invention is to solve or at least minimize the problems associated with the prior art IP mobility mechanisms. The object is achieved with a method and equipment which are characterized by what is disclosed in the attached independent claims. Preferred embodiments of the invention are disclosed in the attached dependent claims.

[0015] The invention is based on the vision that a foreign agent is integrated or consolidated into a support node of a packet radio network. In a GPRS network, suitable support nodes are the gateway nodes (GGSN) and the access nodes (SGSN). In so-called third generation (3G) systems, the SGSN nodes are sometimes referred to as 3G-SGSN nodes. This integration or consolidation is not simple

physical co-location but something more fundamental, wherein the MS can use the foreign agent's care-of-address COA. Thus the MS will not need (consume) any additional IP addresses from the visited network.

[0016] Another advantage of the fundamental integration relates to the time-to-live field of IP datagrams. IP datagrams comprise a time-to-live field which is decremented by one when the datagram is routed by a router or tunnelled by a host (or a GGSN) to a new destination. (The time-to-live field is also called a hop count or a hop limit.) There are two mechanisms by which an MS may gain knowledge of the services offered by an FA. The FA can declare its services using advertisement messages or the MS can send inquiries called agent solicitation messages. These advertisement messages and agent solicitation messages are ordinary IP datagrams with the time-to-live field set to one. If the FA were a separate network element or simply co-located with a support node (GGSN or SGSN), the support node would have to decrement the time-to-live field to zero and then discard the datagram and generate an ICMP (Internet Control Message Protocol) error message upon reception of an agent advertisement message or agent solicitation message. Therefore the FA should be deeply integrated into the support node in a way which does not interfere with the datagrams' time-to-live calculations. In other words, the FA can be said to be integrated into the support node if the support node, which receives a datagram addressed to the FA with a time-to-live field set to one, can forward the datagram to the FA.

[0017] A further advantage of the invention is that Mobile IP support becomes a service provided by the network operator. Thus the operator can also charge the users for this service.

[0018] In order for the MS to keep the existing Mobile IP binding with its home agent, the MS has to reregister with its home agent before the connection times out. The foreign agent or SGSN/GGSN could be thought to perform the re-registration on behalf of the MS (in order to save air interface resources). This is, however, impossible because the MS authenticates the registration messages by using a secret key shared between itself and its home agent. Therefore, neither the FA nor the SGSN/GGSN can do the (re)registration on behalf of the MS, because they don't know the key.

[0019] According to a first embodiment of the invention, the foreign agent is integrated into an SGSN node. According to a second embodiment, the foreign agent is integrated into a GGSN node.

Brief description of the drawings

[0020] The invention will be described in more detail by means of preferred embodiments with reference to the appended drawing on which:

[0021] Figs. 1 and 2 are block and signalling diagrams, respectively, illustrating an IP mobility mechanism according to the first embodiment of the invention; and

[0022] Figs. 3 and 4 are block and signalling diagrams, respectively, illustrating an IP mobility mechanism according to the second embodiment of the invention.

Detailed description of the invention

[0023] Fig. 1 is block diagram illustrating an IP mobility mechanism according to the first embodiment of the invention wherein the foreign agent FA is integrated into an SGSN or a 3G SGSN, commonly referred to as an access node. The MS can be a laptop computer PC connected to a packet radio enabled cellular telephone. Alternatively, the MS can be an integrated combination of a small computer and a packet radio telephone, similar in appearance to the Nokia Communicator 9000 series. Yet further embodiments of the MS are various pagers, remote-control, surveillance and/or data-acquisition devices, etc.

[0024] The Radio Access Network RAN can be a part of a GPRS system or a third generation (3G) system, such as UMTS. The RAN comprises an air interface Um which is a performance bottleneck. Subscriber information is stored permanently in the Home Location Register HLR.

[0025] To cover the entire area of the network, foreign agents FA should be installed in every access node SGSN. Each FA has an IP address in the Internet and in the operator's own private GPRS/3G backbone network. For each access node/FA, a permanent packet data context exists in the corresponding gateway node GGSN to enable tunnelling towards the FA. One of the link protocols between an MS and the access node (e.g. Layer 3 Mobility Management, L3-MM) is modified to support IP mobility.

[0026] Reference is now made to Fig. 2. The user of a mobile station MS subscribes to a special Mobile IP service. The subscription information is stored in the

Home Location Register HLR together with the user's home IP address. There is a permanent GTP tunnel between the SGSN/FA and the GGSN. This tunnel can be configured by network management. In step 2-2 the MS attaches to the packet radio network. In step 2-4 the user of the MS is authenticated, which involves querying subscriber security information from the HLR. In step 2-6, the subscriber information indicates that the MS relates to a mobile subscriber, i.e. a Mobile IP user. The subscriber information also comprises the user's home address. Alternatively, this information could be provided by the MS in the attach request or context activation request message. After the attach procedure, in step 2-8, the MS (or its user) initiates PDP context activation for the IP protocol. In step 2-10 the SGSN/FA creates a context for the MS. The context is created on the basis of the MS's home address and its IMSI. In the PDP context activation acknowledgement message 2-12, the SGSN/FA sends the FA's IP address to the MS. The FA's IP address belongs topologically to the operator's IP network. More precisely, the FA's IP address is such that IP packets destined to that address are routed in the Internet to the GGSN that has the permanent packet data context corresponding to the FA. Having received the acknowledgement, in step 2-14, the MS initiates Mobile IP registration to its home agent HA by sending a Mobile IP Registration Request message to the SGSN/FA. The message from the MS to the FA can be sent on the LLC (Logical Link Control) or Sndcp (Subnetwork Dependent Convergence Protocol) layer. It could also be part of modified L3-MM. Inside the SGSN/FA, the message is forwarded to the FA section (involving no IP routing or time-to-live calculations between the SGSN and the FA). Next, in step 2-16, the FA relays the registration request to the HA (using e.g. UDP/IP, UDP = User Datagram Protocol). In step 2-18, the HA sends a registration reply to the FA which, in step 2-20, finally forwards it to the MS. After step 2-20, there is a Mobile IP tunnel from the SGSN/FA to the HA. If the particular implementation of Mobile IP uses reverse tunnelling, the tunnel exists also in the reverse direction.

[0027] According to the second embodiment of the invention, as shown in Fig. 3, the foreign agent FA is integrated into a GGSN, commonly referred to as a gateway node. In this case the MS uses as its COA the address of the FA in the gateway node. In order to establish mobility binding, the MS has to send additional information to the access node (SGSN). Because of this additional information, the selected

gateway node knows that a received IP address is valid although it does not belong to this particular gateway node. The gateway node detects registration messages from the MS and sends them to its FA unit for processing. Moreover, the gateway node GGSN/SGSN can accept any IP address from the MS and use the address of the FA as the MS's COA.

[0028] As a practical example of the additional information, an access point name (APN) could be used. The APN indicates the operator's name and a Mobile IP address. It is a logical name which the MS sends to the access node and which the access node in turn sends to the gateway node. The access node uses the APN to select a particular gateway node and the gateway node in turn uses it to select a particular ISP. Thus the APN is used for requesting the services of a particular gateway node.

[0029] Fig. 4 is a signalling diagram illustrating the second embodiment of the invention. Signalling steps having identical reference numbers with those in Fig. 2 have identical functions, and they will not be described again. The major difference between the embodiments shown in Figs 2 and 4 is, of course, that in Fig. 4 the FA is integrated into the GGSN instead of the SGSN. Therefore, in step 4-11, the SGSN sends an FA Query to the GGSN+FA. This query is acknowledged in step 4-11'. Steps 4-14 to 4-20 correspond to respective steps 2-14 to 2-20, but they are sent to/from the GGSN, instead of the SGSN. Similarly, the Mobile IP tunnel is established from the GGSN+FA to the HA, and the implementation permitting, also in the reverse direction.

[0030] The description only illustrates preferred embodiments of the invention. The invention is not, however, limited to these examples or the terms used, but it may vary within the scope of the appended claims.

Claims

1. A method for providing Internet Protocol-type, or IP-type, mobility service for a mobile station (MS) in a packet radio network comprising at least two support nodes wherein at least one support node is an access node (SGSN), and at least one support node is a gateway node (GGSN); the method being characterized by:

installing into said packet radio network a foreign agent (FA) having an IP address;

integrating the foreign agent (FA) into one of the support nodes (SGSN; GGSN); and

providing a care-of-address (COA) for the mobile station (MS);

using the IP address of, or provided by, the foreign agent (FA) as the mobile station's (MS) care-of-address (COA).

2. A method according to claim 1, characterized by integrating the foreign agent (FA) into an access node (SGSN).

3. A method according to claim 1, characterized by integrating the foreign agent (FA) into a gateway node (GGSN).

4. A method according to any one of the preceding claims, characterized by using the IP address of the foreign agent (FA) as the mobile station's (MS) care-of-address (COA).

5. A method according to any one of the preceding claims, characterized in that the mobile station (MS), in connection with an attach procedure, sends an access point name (APN) indicating the network operator and a Mobile IP address.

6. A method according to claim 5, characterized in that the mobile station (MS) sends the access point name (APN) to the access node (SGSN) and the access node sends it to the gateway node (GGSN).

7. A method according to any one of the preceding claims, characterized in that a register of the packet radio network, preferably its Home Location Register (HLR), stores information concerning whether or not the

mobile station in question or its subscriber is allowed to use said IP-type mobility service.

8. A method according to any one of the preceding claims, characterized in that the mobile station (MS), preferably in connection with registering, informs the packet radio network whether or not it requests the use of said IP-type mobility service.

9. An arrangement for providing IP-type mobility service for a mobile station (MS), the arrangement comprising:

at least two support nodes wherein at least one support node is an access node (SGSN), and at least one support node is a gateway node (GGSN);

the arrangement being characterized by:

a care-of-address (COA) for the mobile station (MS);

a foreign agent (FA) having an IP address being integrated into one of the support nodes (SGSN; GGSN); and

the IP address of the foreign agent (FA) being also the mobile station's (MS) care-of-address (COA).

10. An arrangement according to claim 9, characterized in that the foreign agent (FA) is integrated into one of the access nodes (SGSN).

11. An arrangement according to claim 9, characterized in that the foreign agent (FA) is integrated into one of the gateway nodes (GGSN).

12. A support node (GGSN, SGSN) for a packet radio network, arranged to provide mobility service for a mobile station (MS), wherein the support node (GGSN) supports at least an IP-type protocol;

characterized in that the support node (GGSN, SGSN):

comprises an integrated foreign agent (FA) having an IP address; and

is adapted to use the IP address of, or provided by, the foreign agent (FA) as the mobile station's (MS) care-of-address (COA).

Abstract

An arrangement for providing IP mobility for a mobile station (MS). The mobile station (MS) has a care-of-address (COA) for routing data packets when the MS is away from home. The arrangement comprises support nodes, called access nodes (SGSN), and gateway nodes (GGSN), and a foreign agent (FA) having an IP address. In order to save IP addresses and radio resources the foreign agent (FA) is integrated into one of the support nodes (SGSN), and the IP address of, or provided by, the foreign agent (FA) is also used as the mobile station's (MS) care-of-address (COA).

(Fig. 1)

1/2

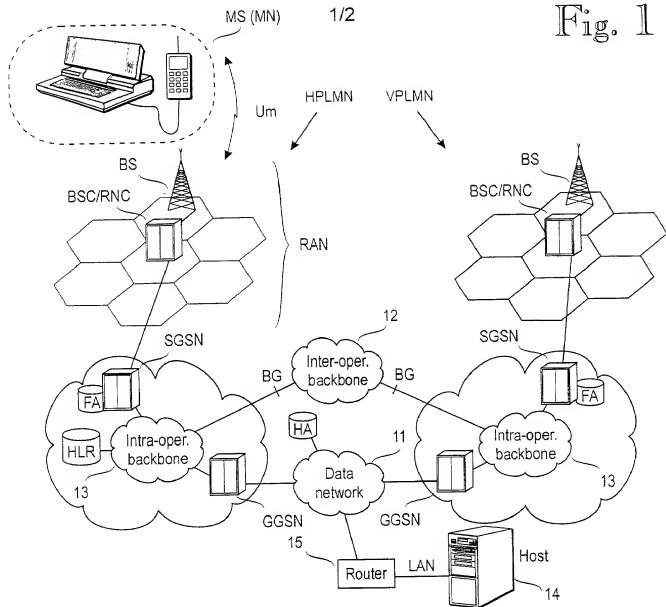
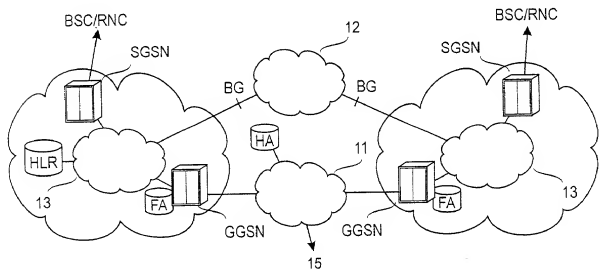


Fig. 3



2/2

Fig. 2

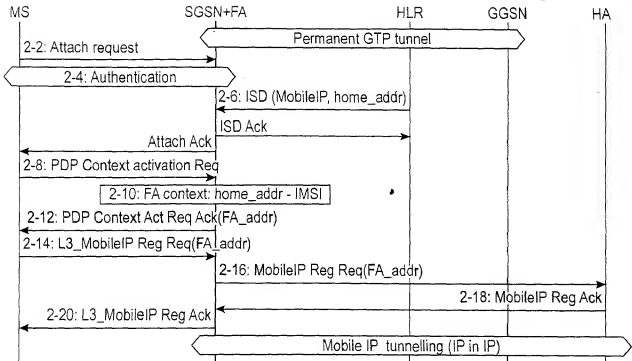
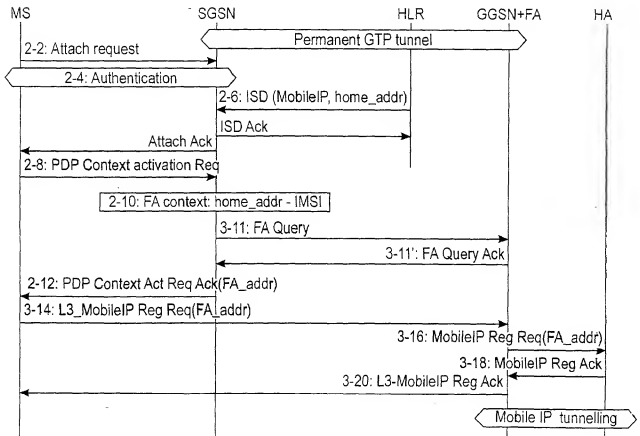


Fig. 4



FOR UTILITY/DESIGN
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DECLARATIONS

RULE 63 (37 C.F.R. 1.63)
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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FORM

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the INVENTION ENTITLED

IP MOBILITY MECHANISM FOR A PACKET RADIO NETWORK

the specification of which (CHECK applicable BOX(ES))

X ☐ A. ☐ is attached hereto.

BOX(ES) ☐ B. ☐ was filed on

as U.S. Application No. /

→ C. X was filed as PCT International Application No. PCT /F199 /00774 on 20 September 1999

and (if applicable to U.S. or PCT application) was amended on

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.56. Except as noted below, I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(c) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International Application which designated at least one country than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International Application, filed by me or my assignee disclosing the subject matter claimed in this application and having a filing date (1) before that of the application on which priority is claimed, or (2) if no priority claimed, before the filing date of this application

PRIOR FOREIGN APPLICATION(S)

Number

Country

Day/MONTH/Year Filed

Date first Laid-

open or Published

Date Patented

or Granted

Priority NOT Claimed

982027

Finland

21 September 1998

If more prior foreign applications, X box at bottom and continue on attached page.

Except as noted below, I hereby claim domestic priority benefit under 35 U.S.C. 119(e) or 120 and/or 365(c) of the indicated United States applications listed below and PCT international applications listed above or below and, if this is a continuation-in-part (CIP) application, insofar as the subject matter disclosed and claimed in this application is in addition to that disclosed in such prior applications. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.55 which became available between the filing date of each such prior application and the national or PCT international filing date of this application.

PRIOR U.S. PROVISIONAL, NONPROVISIONAL AND/OR PCT APPLICATION(S)

Application No. (series code/serial no.)

Day/MONTH/Year Filed

Status

pending, abandoned, patented

Priority NOT Claimed

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

And I hereby appoint Pillsbury Winthrop LLP, Intellectual Property Group, 1100 New York Avenue, N.W., Ninth Floor, East Tower, Washington, D.C. 20005-3918, telephone number (202) 861-3000 (to whom all communications are to be directed), and the below-named persons (of the same address) individually and collectively my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent, and I hereby authorize them to delete names/numbers below of persons no longer with their firm and to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct the above firm and/or a below attorney in writing to the contrary.

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☐ See additional foreign priorities on attached page (incorporated herein by reference).

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